COAL FATAL

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

DISTRICT B

FINAL REPORT OF COAL-MINE BUMP ACCIDENT

NO. 2 MINE
UNITED STATES STEEL CORPORATION, COAL OPERATING DIVISION
WILCOE, McDOWELL COUNTY, WEST VIRGINIA

January 31, 1966

By

J. L. Gilley
Mining Health and Safety Engineer

Morris E. Bragg
Federal Coal-Mine Inspector

Originating Office - Bureau of Mines
Mount Hope, West Virginia 25880
W. R. Park, District Manager
Health and Safety District B

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INTRODUCTION

This report is based on an investigation made in accordance with provisions of the Federal Coal Mine Safety Act (66 Stat. 692; 30 U.S.C. Secs. 451-483).

A coal-mine bump causing fatal injury to one employee and injuries to two others occurred at 4:45 a.m., Monday, January 31, 1966, in the 6 flat right barrier pillar of the No. 1 haulage left section off 7 right in the No. 2 mine. The other 7 men on the section were not injured, and they assisted with the rescue work and administered first aid to the injured. Multiple injuries to Ernest Cassett, roof-bolt machine operator, resulted in his death at 6 p.m., Thursday, February 3, 1966, in a hospital at Charleston, West Virginia. Edward Lambert, continuous miner operator, received injuries and was under treatment in the Steven's Clinic Hospital at Welch, West Virginia. Robert Davis, roof-bolt machine operator, who received minor contusions, was treated in the Grace Hospital at Welch and was released the following day. Cassett, age 54, had 31 years mining experience, 30 of which were with the United States Steel Corporation. He is survived by his widow.

The Princeton office of the Bureau of Mines was notified of the accident by Paul Watson, assistant general superintendent, at 5 a.m., January 31, 1966, and an investigation was begun the same day.

GENERAL INFORMATION

The No. 2 mine, at Wilcoe, West Virginia, is operated in the low-volatile No. 4 Pocahontas coal bed, which is entered through several drifts and shafts. The coal bed averages 84 inches in thickness locally. In the immediate vicinity of the accident, the coal height averaged 80 inches. Total employment is 396 men, 378 underground

and 18 on the surface. Production averages 8,500 tons of coal on a triple shift basis, 5 days a week, and is loaded with continuous miners into shuttle cars.

The mine is developed by a room-and-pillar method. Main entries were driven in sets of 7 and room entries in sets of 5, 16 to 18 feet wide on 65-foot centers. Rooms, 16 to 18 feet wide, were on 45- or 90-foot centers and crosscuts varied from 45 to 90 feet apart. Pillars were recovered by the pocket and the open-end lift methods.

Localized dispositional changes in the immediate roof structure, ranging from sandstone to shales 1 to 4 feet in thickness, are encountered in the 1 haulage left area; however, the roof structure immediately overlying the coal in the 6 flat right barrier area was comprised of light grey shales, ranging from 4 to 24 inches in thickness, overlain by a stratum of dark grey sandstone 6 to 25 feet in thickness. This sandstone is overlain by as much as 6 feet of shaly sandstone containing lenticular coal formations, which in turn is overlain by successive stratum of grey sandstone ranging up to 135 feet in thickness in some parts of the property. The cover over the area of 1 haulage left involved in the outburst was 750 feet.

The floor is a dense, hard, but loosely consolidated sandy shale extending to a depth of about 5 feet, which resists plastic flow, but does heave readily when subjected to excessive pressure. The shale is generally underlain by a thick stratum of sandstone. Very little heaving of the floor was in evidence in the area specifically involved, but heaving of the floor had occurred previous to the outburst at localized areas along the 1 haulage left chain pillars nearest the 6 flat right barrier pillar.

Minimum standards for systematic roof support had been adopted. Roof bolts, installed in accordance with the recommendations of a United States Bureau of Mines roof-control representative, were used in all working places. In addition to roof bolts, hydraulic jacks and two or more rows of permanent posts with cap pieces are required on the open end of pillar lifts. Hydraulic jacks, or 4 cribs, in conjunction with posts are installed when "push out" blocks are mined. Nine roof jacks are required for temporary support before roof-bolting operations are begun, and persons are prohibited from working inby roof supports.

Members of the investigating committee were:

Company Officials

C. W. Connor, Jr.	General Superintendent
P. E. Watson	Assistant General Superintendent

J. E. Caffrey	Chief Engineer
W. S. McConnell	Chief Mine Inspector
Martin Hayduk	Mining Engineer
R. B. Anderson	Mine Superintendent
F. J. Gergely	General Mine Foreman
D. V. Webb	Mine Inspector
E. A. Keiling	Assistant Mine Foreman
Alex Garnett	Assistant Mine Foreman

United Mine Workers of America

J. C. Blair	Chairman, Mine Safety Committee
Ewing Sopsher	Member, Mine Safety Committee
Jerry Harriston	Member, Mine Safety Committee

West Virginia Department of Mines

Harry Harman	Inspector-at-Large
Edward Jarvis	Assistant Inspector-at-Large
Thomas Pettry	District Mine Inspector

United States Bureau of Mines

J. L. Gilley	Mining Health and Safety Engineer
Morris E. Bragg	Federal Coal-Mine Inspector

The preceding Federal inspection was completed October 28, 1965.

DESCRIPTION OF OCCURRENCE .

On the day of the outburst, the 1 haulage left night shift crew, consisting of 9 workmen and a foreman, arrived on the section at about 12:45 a.m., and normal coal production operations were started soon thereafter. Three probe holes had been drilled, each to a depth of 85 feet by the day shift on January 28, 1966, with a 24-inch diameter auger into the 6 flat right barrier "bump block", according to the company's augering plan in an effort to relieve, progressively, the imposed stresses on this pillar.

The secondary development phase of mining in this "bump block" consisting of enlarging the auger holes to the normal room width of 16 to 18 feet and full seam height with the continuous miner, and this was started on the 4 p.m. shift on January 28, 1966. This secondary development phase had been accomplished during the 12:01 to 8 a.m. shift on Saturday, January 29, 1966, to a depth of 55 feet (from the centerline of the entry) according to plan in A, B, and C places, respectively, subsequent to turning the crosscuts to the right to connect the 3 places and hole into the gob from "A" room, as indicated in Sketch 1.

Information obtained during this investigation was that the section foreman informed the workmen, prior to start of mining operations on the shift the outburst occurred, not to perform any work in places immediately adjacent to the one in which coal was being mined with the continuous miner. Initial work assignments to the continuous miner crew were to start mining coal in the A room crosscut, which was projected to intersect a flanking gob area, and the roof-bolting crew was to complete bolting the roof in C room. After about 16 linear feet of coal was mined in the A room crosscut, the miner was moved into B room and mining of the crosscut was started toward A room. During the interim, the roof-bolting crew completed their roof-bolting assignment in C room.

Mining operations during the shift had been interrupted because of sporadic power failures and mine car supply. During one of the interruptions or delays while the miner was in the B room, but idle, the roof-bolting crew was instructed by the section foreman to tram the roof-bolting machine into the A room and install the required safety jacks in the A room crosscut. Reportedly, the roof-bolting crew received further instructions not to do any roof-bolting in the A room crosscut until the mining cycle (16 linear feet of coal) in the B room crosscut was completed and the miner had vacated the place. The foreman then proceeded to investigate the reason for the delay. During the interim, the roof-bolting crew set the required safety jacks in the A room crosscut and vacated the place until after the mining cycle had been completed in the B room, and the miner had been trammed into C room, where mining of the crosscut toward B room was started.

The roof-bolting crew, Cassett and Davis, completed roof-bolting the roof in A crosscut at about 4 a.m., and took their lunch period while mining operations continued in C room.

Notwithstanding the fact that company standards prohibit any work or travel to be performed by employees in a place immediately adjacent to the one in which loading or mining operations with a continuous miner are in progress during mining of "bump blocks", the roof-bolting crew, upon completion of their lunch period at about 4:30 a.m., trammed the roof-bolting machine into B room and began to install safety jacks while mining operations were in progress in the adjacent C room. Seven jacks had been set and the eighth jack was in the process of being set when the outburst occurred.

Kenneth McKaughan, shuttle car operator, one of the workmen caught in the coal outburst in C room, but uninjured, stated that approximately 8-1/2 cars or about 80 tons of coal had been mined in C room crosscut and that the shuttle car in the process of being loaded was about three-fourths full when the outburst occurred at

4:45 a.m. A total of 30 mine cars, or about 275 tons of coal, had been loaded in the three places during the shift.

The location of the men and equipment and the extent of augering and secondary mining in the 6 flat right "bump block" are indicated in detail in Sketch 2. The active area of 6 flat right and the extent of extraction in the 1 haulage left section when the coal outburst occurred are indicated in Sketch 3.

From Sketch 1, it will be noted that the 6 flat right barrier pillar originally was 400 feet in length and ranged from 185 to 240 feet in width. Initial mining in this barrier pillar consisted in the development of an auxiliary entry projected on 45-foot centers from the No. 5 entry of 6 flat right and extended the full length of the barrier pillar, thus forming a block of coal 400 feet long and 142 feet wide. Five rooms, on 47-foot centers, were subsequently developed in the barrier and the respective pillars were extracted, as indicated in Sketches 1 and 3. This process further reduced the barrier pillar to a block, locally designated as a "bump block", 142 feet in width and 162 feet in length. This block, as previously mentioned, had been probed by drilling three holes with a 24-inch diameter auger on 45-foot centers to a depth of 85 feet each in an endeavor to relieve the cumulative internal stress in the pillar, according to adopted plans for drilling and mining "bump blocks".

Auger drilling in an effort to control outbursts at the No. 2 mine, the only mine in this county in which this method had been adopted, has achieved considerable success. The augering is done with two permissible-type Joy drills, Model AD-12 and Model AD-10 MS-1-1, both self-propelled, caterpillar mounted, and hydraulically operated. In principle, these drills are very similar to some of the drills used in surface auger mining. The auger sections are 24 inches in diameter and 4 feet in length. The auger holes in "bump blocks" currently are seldom extended beyond 85 feet from the same set-up or drill site; however, in many instances, holes have been drilled to greater depths. As a matter of information, it is of great importance that the holes be drilled on the mine floor and some of the auger holes, after completion, are as much as 10 feet in width and extend from floor to roof. These large peripheries are caused by the auger leading off centers, persistent wallowing or rifling of the holes by the auger train, and from frequent bumping of the coal during augering. It is desirable, however, that the auger holes be wide and of full seam height so as to permit lateral movement of the coal and gradual relief of pressure rather than spontaneous relief.

The A, B, and C holes in the "bump block" involved in the accident, were reasonably straight, about 5 to 8 feet in width and of full seam height; however, each hole was approximately one-half full of coal after augering. Augering of the A hole was started on Friday, January 14 and augering of the third or C hole was completed on Friday, January 28. Considerable difficulty was experienced in augering the A and B holes caused by the auger train becoming fouled, twice in A hole and once in the B hole to the extent that sections of augers broke on at least three occasions during the process of augering and/or extricating the train of augers at depths less than 30 feet in the pillar.

Four hydraulic pressure cells, to record pillar pressure changes, were installed in holes drilled to a depth of 40 feet in the 6 flat right barrier pillar at the locations indicated in Sketches 1 and 3 on October 12, 1965. This project was in connection with the special cooperative research of investigative outburst problems by the company and United States Bureau of Mines. Maximum pressures recorded at these test sites during the period of January 10-25, 1966, when the equipment became inoperative (supply lines were severed by internal movement of the coal) ranged from 6,700 to 9,100 p.s.i.

Difficulty experienced in augering the three probe holes in the front side of the "bump block" and the comparatively high pressures recorded by the hydraulic pressure cell equipment along the back or gob side of the pillar approximately three weeks prior to completion of augering, indicated that this and other pillars of like dimensions under similar condition are subjected to tremendous stresses.

Mining of "bump blocks" under the present system at this mine therefore can be very hazardous, especially when it evolves secondary development (mining) in the highly stressed portions of a pillar situated within an abutment zone from lead impingement of converging gob lines with ultimate loading from four sides. The 6 flat right "bump block" involved was no exception.

The outburst was violent in nature, in that large amounts of coal were expelled violently from the immediate face areas of the A, B, and C places, and coal was also shaken from one or more ribs of 6 adjacent pillars, as indicated in Sketch 3. The roof was affected (cracks) to minor extent in each of the working places and slight localized floor upheaval was noted.

The continuous miner operator was thrown from the deck of the miner to a position between the miner and shuttle car in C room, as indicated in Sketch 2, when this equipment was thrust outward about 6 feet from its original operating position prior to the outburst. McKaughan, shuttle car operator, was thrown from the deck of the shuttle car but was uninjured.

Cassett (victim) was thrown against a hydraulic roof jack by the shock wave and coal outrush and was found in an almost upright position, covered with coal to the neck. Davis was also struck and partially covered with expelled coal. Considerable damage was incurred to the mechanical and hydraulic components of the continuous miner and shuttle car in C room. Also, two hydraulic roof jacks were broken and the other four were bent in the B room. Dense clouds of dust were thrown into suspension, but, reportedly, no methane was detected with a flame safety lamp in the area affected by the outburst. The section foreman and a workman, who were near the cutout switches, cut off the electric power within a few seconds following the coal outburst.

Recovery operations were conducted and first-aid rendered to the injured under direction of the mine superintendent, general mine foreman, chief mine inspector, assistant safety inspector, and assistant foremen. Workmen from other parts of the mine assisted those uninjured on the 6 flat right section in the recovery operations and in administering first aid.

CONCLUSIONS

This coal outburst is the result of an accumulative process, and factors believed to have contributed to the cause of this outburst include:

1. Natural conditions favorable to pillar outbursts, consisting of as much as 750 feet of cover, a massive sandstone roof that either contacted or was close to the coal bed, and a hard dense sandy siltstone floor material that resisted yielding were present in the area involved.

2. The pillar involved, because of its size and shape, possessed considerable load-carrying capacity and its location with respect to gob areas formed a highly stressed pillar-line point area, a location where the greatest percentage of coal outbursts occur.

3. Secondary development (mining) was being done in a highly stressed pillar within a compounded abutment zone from two gob lines, which also are constraining factors.

4. Reduction of the pillar to form a "bump block", and then the inability, under the adopted plan, to subsequently auger the pillar sufficiently to relieve the accumulated internal stress and thus attain the required degree of safety prior to doing secondary development within such pillar was a prime factor in this coal outburst.

5. The company's rule prohibiting persons, when mining "bump blocks", from entering and/or performing work in a place adjacent to the one in which mining operations were being done was not followed. The fact that the roof-bolting crew, in violation of this rule, entered and performed work in the B room adjacent to C room, in which a continuous miner was mining coal contributed to the seriousness of this accident.

6. A suitable shield or guard was not provided on the continuous miner to afford protection to the miner operator when exposed to ribs of highly stressed pillars.

RECOMMENDATIONS

Compliance with the following recommendations may prevent accidents of a similar nature:

1. Under no circumstances should secondary development, including the present plan for augering and mining of "bump blocks", be done in over-stressed coal pillars within the abutment zones of the extraction lines.

2. Coal pillars should be developed as near in uniform size and shape as practicable, and sufficiently in advance of the progressive outward movement of the abutment load so as to minimize focus of stresses on individual pillars. This includes "bump blocks" to be augered and mined under the present augering plan.

3. In pillar recovery under hard massive roof which resists caving, every precaution should be taken to extract the coal pillars in a manner that will permit, insofar as practicable, orderly distribution of stresses.

4. Future mining projections should eliminate, insofar as possible, the number of vulnerable pillar-line point areas (pillars projecting into gob areas).

5. The company's rule prohibiting work or travel in places immediately adjacent to the place in which mining operations are being done, should be strictly complied with. This includes development of "bump blocks" and rooms in areas vulnerable to coal outbursts.

6. A protective shield or guard should be provided on continuous mining machines for protection of the operators when exposed to ribs of highly stressed pillars.

ACKNOWLEDGMENT

The cooperation of company officials, employees, members of the United Mine Workers of America, and representatives of the West Virginia Department of Mines during this investigation is gratefully acknowledged.

Respectfully submitted,

/s/ J. L. Gilley

J. L. Gilley
Mining Health and Safety Engineer

/s/ Morris E. Bragg

Morris E. Bragg
Federal Coal-Mine Inspector

Approved by:
/s/ W. R. Park

W. R. Park
District Manager

APPENDIX - SKETCH NO. 1

6 Flat right 1 haulage left barrier pillar
Proposed mining and augering plans for "bump block"

MINING PLAN

Step I - Sequence of mining had been completed prior to this outburst as indicated.

Step II - Drill holes A - 90'
B - 90'
C - 90'

Step III - Mine sequence 1 through 17 inclusive

Step IV - Drill holes D - through to Gob (85' ±)
E - through to Gob (85' ±)
F - through to Gob (85' ±)

Step V - Mine sequence 18 through 35 inclusive

* * * *

Note: Location of hydraulic pressure cells in barrier pillar as shown.

DRILLING PLAN

1. Drill rig shall not be positioned less than 35' from face to be drilled.
2. All holes referred to on this print shall be drilled with a 24" diameter auger.
3. A barricade of 2 rows of cribs (4 cribs in each row) shall be erected inby each drilling position with plastic shield on outby row.
4. Drilling and loading sequence abutting the bump block shall not be conducted on the same shift.
5. Miner shall not advance beyond a point 35' from the outby end of auger hole.
6. Auger hole being loaded outby miner and hole adjacent shall be re-drilled if closed by subsidence.

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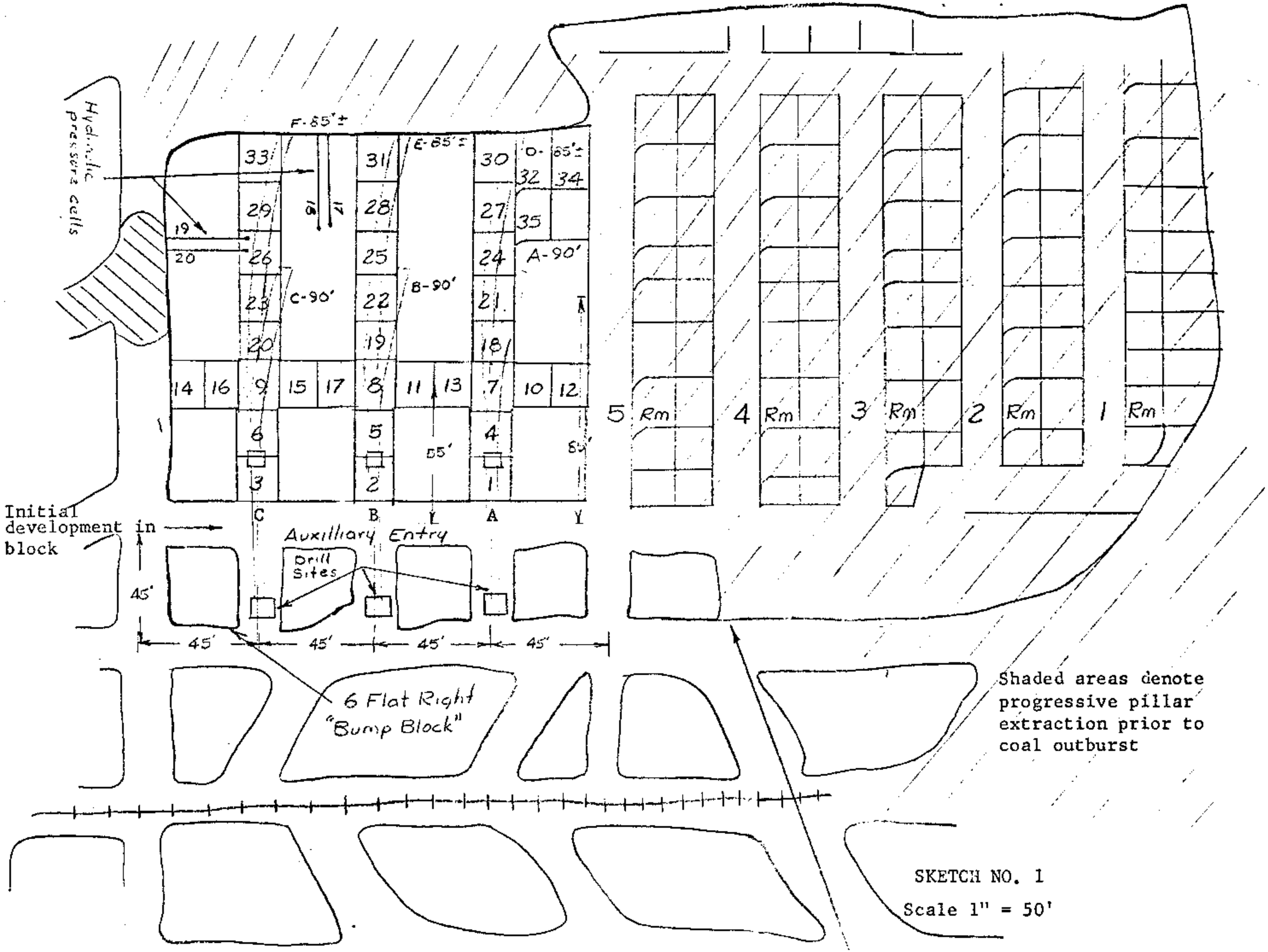
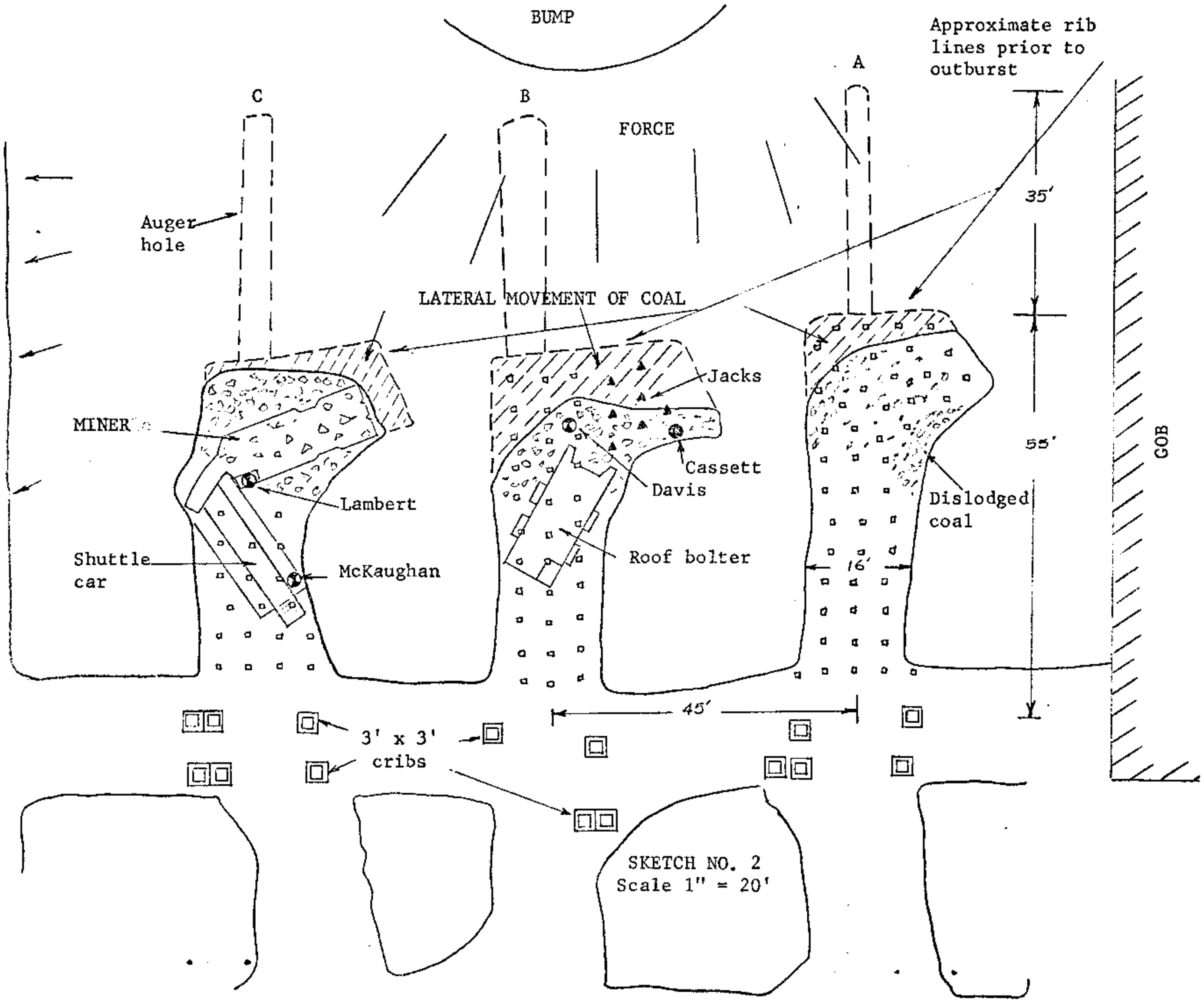


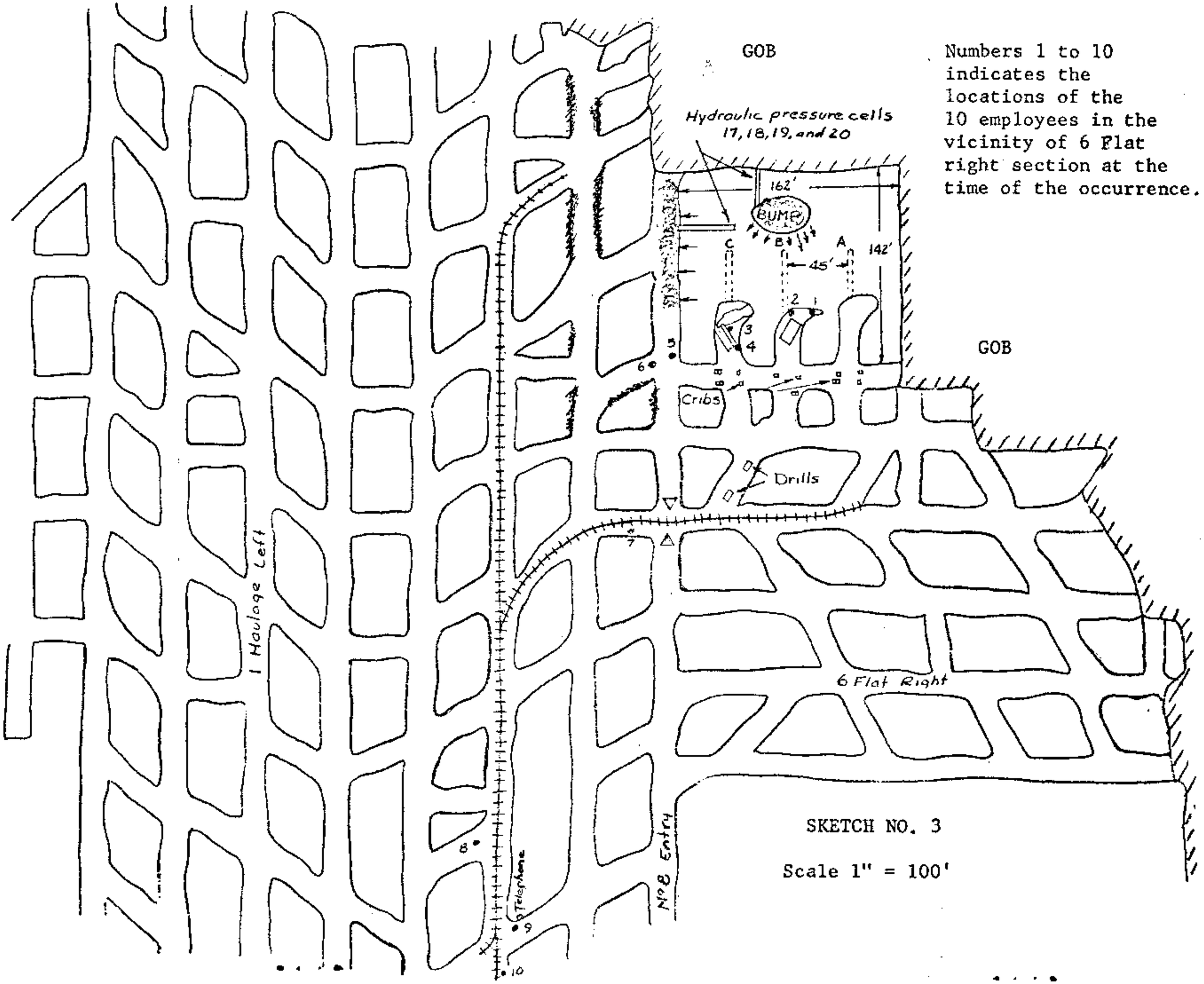
Shaded areas denote progressive pillar extraction prior to coal outburst

SKETCH NO. 1

Scale 1" = 50'



SKETCH NO. 2
Scale 1" = 20'



Numbers 1 to 10 indicates the locations of the 10 employees in the vicinity of 6 Flat right section at the time of the occurrence.

SKETCH NO. 3

Scale 1" = 100'